Vol.X No.9 November 1981 Second class postage paid at Dallas, Texas Postal Identification
Publisher, Jim Cranshaw Monthly except July and August Statement, page 2
Price $7.00 yearly Single issue $1.00

THE NEWSPAPER FOR
THE HOBBYIST OF VINTAGE
ELECTRONICS AND SOUND

# THE HORN SPEAKER

## the true story of Heinrich Hertz

**Who found that waves produced by the spark of an electrical machine could be received by a circular loop of wire and was able to show the reflection, refraction, diffraction and polarization of the waves**

DECEMBER, 1915

*By Raymond Francis Yates*

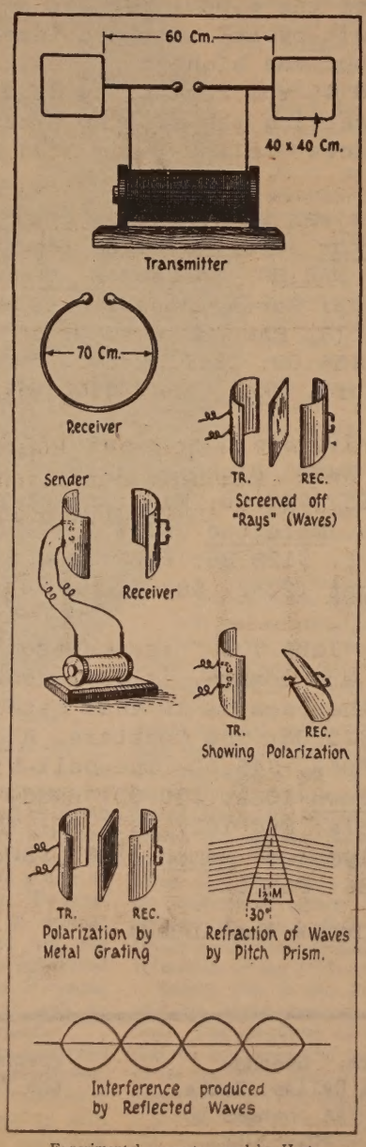
THE German physicist, Heinrich Hertz, was born at Hamburg in 1857. He studied to become a civil engineer, but forsook this profession for the study of mathematics and pure science, which he pursued at Munich and Berlin, becoming Helmholtz's assistant at the latter university in 1880. His earlier experiments with electromagnetic waves were performed during his professorship of physics at the Polytechnic Institute at Karlsruhe, and made for Hertz such a reputation that he was in 1889 called to the important chair of physics at Bonn, previously occupied by Clausius. To Hertz is due the realization and detection of the electromagnetic waves which Maxwell had discovered in his theoretical consideration of the nature of electricity.

The first paper describing these wonderful discoveries was published in 1887 and the series continued for several years in Wiedermann's Annalen. In 1890 was published Ueber die Beziehungen zwischen Licht und Electricitat, while his Gesammelte Werke were published in Liepzig the year after his death. English translations entitled Electric Waves, by D. E. Jones, with a preface by Lord Kelvin (1893), and Miscellaneous Papers, by D. E. Jones and G. A. Schott, with an introduction by Philipp Lenard (1896) have been published.

That Hertz's classical experiments were inspired by our own Thomas Edison is not generally known. It was during one of the industrial exhibitions in Paris in the early eighties that Edison displayed for the first time a very mysterious black box. It was arranged at one side of the booth and he placed within it a tiny spark gap. A peep hole allowed the curious visitors to observe the gap.

On the opposite side of the booth there was a heavy induction coil connected to another spark gap. When this coil was operated a tiny spark was seen to pass across the gap located in the little black box. From the

(Continued page 2)




Experimental apparatus used by Hertz

## Reminiscences

### The Story of an Operator Regarding Incidents at Sea and Ashore

**By Irving Vermilya**

ALTHOUGH the ranks of the United Wireless operators are gradually thinning out there are still a number of them in the Marconi service and, like myself, I suppose they take pleasure in recalling the old days when there were no regulations at all and the fellow with the most power in kilowatts had the best show. Most of my old United days were spent on board the North Star of the Maine Steamship Company, or the same owners' Northland. Indeed even my Marconi days, up until about a little more than a year ago, were spent on the Northland, with the exception of one trip on a private yacht. If anybody in those days mentioned wireless on the North Star or Northland, their thoughts involuntarily turned to either old Hiram Hilkins or myself; it seemed as if there was a permanent arrangement under which we swapped ships every once in a while, so as to break the monotony of the same crowd and scenery.

The North Star, back in the United days, when only one operator was aboard, was surely some job. My chief duty was to call up 42 Broadway and let him know we had left without slamming off the posts of the dock. Then I would listen to the talk of a few amateurs up the East River, and send in our O. S. report at every old rock we passed all the way to Stratford. Along about 10 p. m. I would call old WN (Wilson's Point, Conn.) or BG (Bridgeport) and say ND—nothing doing—and give them a good night. There was nothing to do then but go to bed. I laugh when I think of that bed. It was a box hung on the wall inside the wireless coop and supported by two chains. Every time the boat pitched the chains doubled up and I would have to hang on to the helix to keep from going out on the floor. The wireless house was only about eight feet by six, and about seven feet high; in consequence the box which served for a bed was less than five and one-half feet long and three and one-half feet wide. I am six feet tall. You can imagine how I fitted in. But despite the uncomfortable conditions I stuck to the old ship for a number of years; and after the Marconi Company took over the United, conditions were bettered and I willingly stayed on that line.

I became a wireless operator in rather an unusual way, I think. Long before there was any United Company and when the Marconi was quite young, I put up an amateur station at my home in Mt. Vernon and tried to get in touch with a fellow in New York. I failed because I did not know how much power was necessary to go fifteen miles overland. I was trying to do it with a two-inch coil, and as detectors were crude at that date, there was nothing doing. I heard my friend, however, for he had a sixteen-inch coil and plenty of power. With the assistance of a liberal father I gradually saved up enough money to secure a one-quarter k.w. transformer. This made quite a disturbance, but not enough; so I kept getting larger transformers until I eventually obtained one of the 5 k.w. closed core type. This made considerable rumpus, and my efforts to equip other amateurs so as to have some one to talk to, became so energetic that one day I received a letter from the United company offering me a job, providing I would shut up my station while away. This looked good to me, but the job was to be on an old oil

(Continued page 3)

standpoint of pure science, this experiment was one of the features of the whole exposition. Many of the great scientists of Europe were awed at the remarkable demonstration. The best of them could not quite understand what was taking place. In fact, Edison himself was quite at sea.

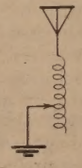
One day a gaunt young man with a long, thin face smoothly shaven wandered through the exhibit and stopped at Edison's booth. He casually stepped up to the little box and peeped into it. That was an important moment in the history of radio, for it marked the birth of the inspiration that later gave the world a new art of communication. When this young man saw the mysterious spark, the thought of James Clark Maxwell and his electromagnetic theory of light flashed through his mind. This, he argued to himself, is no doubt caused by some of the electromagnetic waves that Maxwell had accounted for in his mathematics.

The young man mentioned was none other than Prof. Heinrich Hertz of the University of Bonn, Germany. Hertz was twenty-eight years old at the time and bubbling over with the ambition to make his mark in the world of science. Indeed, his mind was restless and his fingers twitched until he had arrived back at the laboratory of the university where he later not only proved the correctness of Maxwell's wonderful reasoning, but placed in the hands of the world a new and powerful instrumentality.

That Hertz's commercial vision was by no means as keen as his experimental vision is proven by the part of his paper where he says, "We have applied the term rays of electric force to the phenomena which we have investigated. We may perhaps further designate them as rays of light of very great wave length. The experiments described appear to me at any rate eminently adapted to remove any doubt as to the identity of light, radiant heat and electromagnetic wave motion. I believe that from now on we shall have greater confidence in making use of the advantages which this identity enables us to derive both in the study of optics and electricity."

It is evident that Hertz's interest in pure science was in no way dimmed by commercialism. He was essentially an investigator and cared little or nothing for invention. He formed a part of that preciously small army of experimenters who prepared the fertile soil in which many of our great inventions of the day took root.

Immediately Hertz got back to the laboratory he set up a crude form of oscillator and from the results of his first experiments with it it is pretty certain that he was sure of just what he was doing. The brass balls of his oscillator were separated by a spark gap about seven millimeters long. A Ruhmkorff coil supplied the oscillator with its high voltage discharge.



When this oscillator was operating, Hertz visualized electromagnetic waves spreading out from it, and to prove that they were present he built the simplest radio receiver that could possibly be produced. It was formed by a loop of wire 70 centimeters in diameter. This loop was broken so that a tiny spark gap would be formed between its ends. The total length of the wire forming the loop corresponded with the length of the oscillator, for it was evident to Hertz that his transmitter and receiver would have to be in tune with it.

Hertz took his small receptor and walked about the laboratory with it. At certain points he noticed a little spark passing between the tiny spark gap. It must have thrilled him for he then knew that there was an actual transference of energy between his oscillator and receptor. Furthermore he must have known that he was deal-

# off the record

Re: RESULTS OF RECENT MAIL AUCTION OF COLLECTIBLE PHONOGRAPH RECORDS.

L. R. "Les" Docks, of San Antonio, Texas, reports that supplying record collectors' wants remains a "sound business." Docks' assessment is based upon the results of his largest record auction to date, which consisted of several sections: 78 rpm hillbilly, country-western, western swing, and cajun; 78 rpm jazz, dance bands, swing, "sweet" bands, personalities and popular vocalists; 78 rpm blues, rhythm & blues, gospel and other "race" records; 78 rpm rock 'n' roll, rhythm & blues, rockabilly, and popular hits of the late 1950s (usually found in 45 rpm form); 45 rpm rock 'n' roll, rhythm & blues, blues, rockabilly, novelty. Most of the 6,000+ records offered were sold (although there are some left-overs). Intense interest was apparent in each category offered, but the highest prices, as expected, were brought by 78 rpm blues and 45 rpm rockabilly discs. Some highlights of the auction- records receiving the most spirited bidding, but not necessarily the highest prices, follow (presented by artist, label, and number)

Bidding on blues records was particularly heavy, exemplified by: Jim and Andrew Baxter, Victor 38603, $72.28; Leroy Carr & Scrapper Blackwell, Vocalion 02681, $68.88; Bo Carter, Okeh 8897, $52.51; Daddy Stovepipe & Mississippi Sarah, Bluebird 6023, $100.00; Walter Davis, Bluebird 5931, $107.18; Famous Hokum Boys, Romeo 5042, $62.90; Bill Gaither, Decca 7141, $55.00; Clifford Gibson, Victor 38562, $80.60; Mississippi John Hurt, Okeh 8654, $50.00; Jazzbo Tommy & His Lowlanders, Melotone 7-05-79, $35.55; Robert Lee McCoy, Bluebird 7115, $50.00; Memphis Jug Band, Bluebird 5430, $53.90; Mississippi Jook Band, Melotone 6-11-65, $40.00; Mississippi Sheiks, Bluebird 5881, $35.11; George Noble, Melotone 7-06-75, $460.00; Peanut, The Kidnapper, Melotone 7-09-65, $128.88; Robert Petway, Bluebird 8987, $40.00; Ma Rainey, Paramount 12252, $88.11.

Increased interest in "late 78s," issues from the late 1950s whose 45 rpm counterparts are common, is obvious from the numerous bids received on many of the records in that category, most notably: Chuck Berry, Chess 1729, $23.06; The Coasters, Atco 6146, $48.00; The Crickets, Brunswick 55053, $45.00; The Dell-Vikings, Dot 15592, $25.00; The Fiestas, Old Town 1062, $30.00; Buddy Holly, Decca 29854, $46.26; The Imperials, End 1027, $35.06; The Mello-Kings, Herald 502, $30.00; The Olympics, Demon 1508, $30.00; Elvis Presley, RCA Victor 20-6636, $65.12.

(To be continued)

**POSTAL IDENTIFICATION STATEMENT**
The Horn Speaker (USPS 956120) is published monthly, except July and August by Jim Cranshaw, 9820 Silver Meadow Dr., Dallas, Texas 75217. Subscription rates are $5.50 per year, $11.00 two years. Second-class postage paid at Dallas, Texas. POSTMASTER: Send address changes to The Horn Speaker, P.O. Box 53012, Dallas TX 75253.

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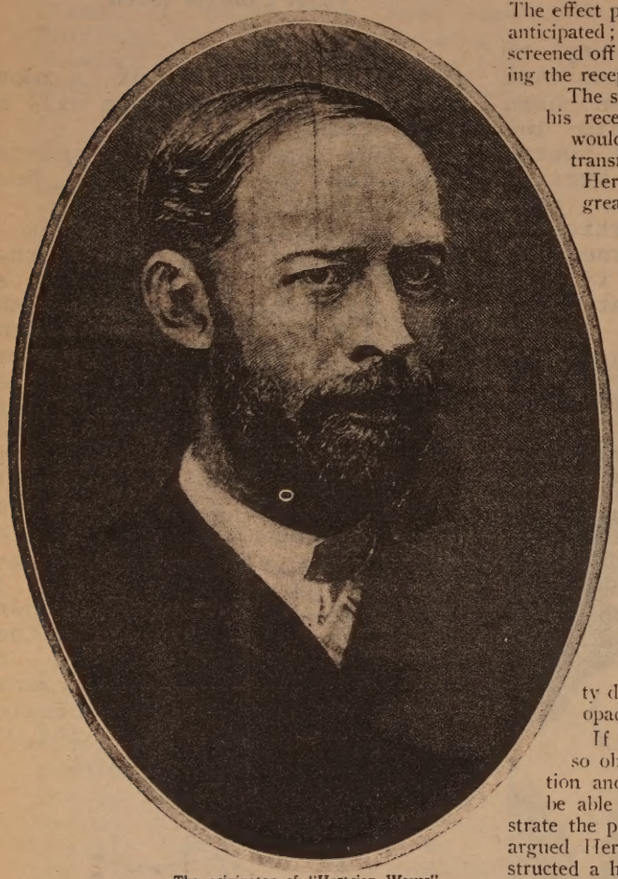
ing with a wave motion, for he could easily knock his receptor out of tune with the transmitter.

Inspired by this success, Hertz enthusiastically jumped in to a series of experiments that have since marked him as one of the world's greatest minds. He put these newly discovered waves through all the experimental antics that could be imagined. He played with them as a child plays with a new toy.

His next experiment was performed to demonstrate that these waves had all the properties of light waves. To do this he made use of the phenomenon known as interference and in this he was probably guided by Young's classical experiment in light made a number of years previous Hertz set up a metal reflector and interposed between it and the oscillator his simple receiver. By changing the position of the receiver he reached points where he found that no spark



The originator of "Hertzian Waves"

occurred between the balls of the receptor. This, he reasoned, was due to the interference caused between the reflected waves and the waves from the oscillator that were on their way to the reflector. In doing so he demonstrated that there was a unit of electric force at the reflector. By moving his simple receptor to various positions he easily picked out the points at which the waves interfered with each other. This was of course at their crossing points as will be understood from the illustration.

Searching further into the mysteries of electromagnetic wave phenomena, Hertz set up and used a transmitter and receptor capable of dealing with shorter wave lengths. The apparatus used was not unlike that first employed, save that it was connected to

## HEINRICH HERTZ

cylindrically shaped reflectors. The wave generated had about 1/10th the length of the one originally employed.

The first experiment made with the new equipment demonstrated the fact that radio waves, like light waves, are capable of casting a shadow. To demonstrate this Hertz simply interposed a metal screen in a direct line between his oscillator and receptor. The effect produced was exactly as he anticipated; the waves were entirely screened off and prevented from reaching the receptor.

The simple expedient of turning his receptor to a point where it would be at right angles to the transmitter showed polarization. Here again Hertz showed the great similarity between light waves and electric waves. Not satisfied with this proof, he made further experiments in polarization by interposing between the receptor and transmitter a grating of wires and he anticipated that this simple apparatus would act in the same way as tourmaline crystals when applied to light. Still again he found his assumption was correct, for the simple wire grating was capable of controlling the passage of the waves. When the wires were in a horizontal position the waves passed freely, but turning the grating ninety degrees caused it to become opaque.

If these electric waves follow so obediently the law of reflection and polarization, one should be able to cause them to demonstrate the property of refraction. So argued Hertz and forthwith he constructed a huge prism of pitch. This prism was 1½ meters high and had a total weight of 1,200 pounds with a refracting angle of 30 degrees. Setting his receiver and transmitter up as illustrated, Hertz shot his newly discovered waves through the pitch. Again his action and forethought were vindicated for the waves were bent to an appreciable extent upon passing through the huge pitch prism. Calculations of Hertz placed the index of refraction of the pitch at 1.69.

Briefly, this is the story of Hertz and his history-making experimentation. The simplicity of the apparatus that he employed and the positiveness of its operation when in the hands of even the most rank experimenter make it possible for any novice to reproduce the original experiments in all their beauty and accuracy. There is nothing intricate or difficult about them.

tanker and I immediately side-tracked it. Not long afterward the Caracas, a Red D Line passenger ship, was offered, and I set out on my first trip to South America.

I thought afterwards that I had plenty of nerve to go to South America first trip, for I had never been out of sight of land before. I was seasick for eleven days. When I finally overcame the malady, however, I enjoyed myself very much. We landed at Caracao, a Dutch island, and there I had my first experience in a foreign land. I can well recall coming to a bridge which I wanted to cross, but I was held up at the entrance and the gateman said something to me I did not understand. I told him to talk United States, whereupon he gave me a card printed in English which stated that to cross the bridge it cost one cent if you took your shoes off, and two cents if you wore your shoes. I burst out laughing. I was tempted to take 'em off, but on second thought I paid my two cents. I did not have any pennies, it so happened, so I gave him a nickle. He refused to take anything but silver, and as a quarter was the smallest change I had in silver, I gave him this. You should have seen the change he gave me! There was so much of it, it looked to be about forty-eight dollars in copper, brass, iron, zinc, tin, bronze and (in one small coin) what appeared to be wood.

It filled both my coat pockets and when I had crossed the bridge I was glad to come upon a small car pulled by a mule. I got aboard and had a very nice ride; everything went well, in fact, until I tried to pay my fare. He who discharged the dual functions of conductor and driver stopped the car and came around when the proper time arrived. I was the only passenger, and he evidently knew I was an American, for he asked me for a ten-cent coin. I wanted to give him some of the junk the bridge man had given me, but he did not seem to want it. I gave another quarter finally and the junk money he returned filled another pocket. I was given a little receipt for my fare, and also a blue ticket with something written on it. Afterward, when I met a man who spoke English, he told me it was a sort of a receipt to show I was a perfect gentleman.

I had a chance to demonstrate whether his surmise was correct when I was sent aboard the yacht Emeline as operator for Robert Graves and had one of the finest trips imaginable. We started for the Panama Canal and all enjoyed every moment of the voyage. The yacht was furnished luxuriously. We carried a cabaret along, consisting of Hawaiian singers and dancers and a moving picture apparatus which I operated in the evenings, and for which the owner paid me a special salary. There was also an automatic piano, a $1,500 organ, electric chimes and an electric fountain which sent forth streams of perfumed water. We were headed for Kingston, Jamaica, but one of the ladies' dogs got seasick and we to turn back and land at Norfolk, Va. While we were in Norfolk a funny incident arose. Mr. Graves had forgotten the combination on the safe, and as he wanted to purchase some supplies he did not know what to do. We finally found a safe opener by trade and after a few moments of tinkering he opened it. I came on the scene about the middle of the operation and was given an awful scare—I thought it was a robbery in full swing! I did not send an S O S, but I did something about as bad: He was a tough looking individual and I asked him what he did at night. This got his temper up and he told me a few things.

# Horn Contour

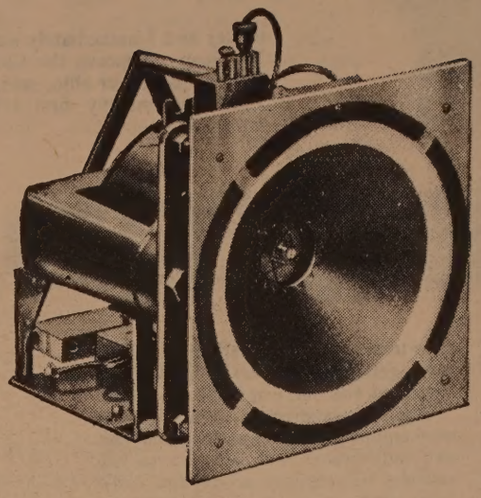
**continued** *by* BRUCE C. EDGAR

SB: What were the developments leading to the formation of Voigt Patents Ltd?

VOIGT: It was in the 1920's while at Edison-Bell that I learned enough about magnets to design high-flux-density loudspeaker magnets properly. Those design principles were discussed in detail in my British Patent number 331,209.

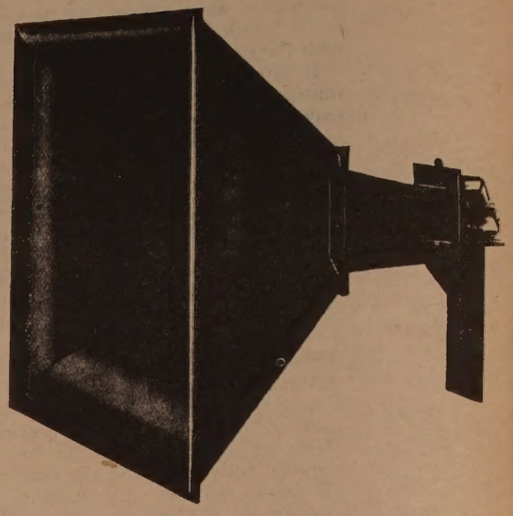
Excited field speakers, made under my patent by Edison-Bell, supplied with 40 to 50 watts excitation power gave a flux density of 16,000 to 17,000 gauss across a 2 mm gap, and were used for cinema work, high quality public address, etc. Edison-Bell "died" in the slump (1933), so my own business was started to keep the speaker alive.[3] (See Figure 5).

SB: How did you design your domestic corner horn? (See Figure 6).



Voigt Excited Field Loudspeaker

Edison Bell Power Loudspeaker
(Voigt Patents)



Voigt Cinema Horn [14]

VOIGT: The simplest way to visualize it is to imagine that my cinema square section horn is facing downward onto the floor and that it is the bottom portion of a rather distorted pyramid. Then it is sawn into four parts by sawing vertically downwards from one corner to the opposite one. Now if you place one of the quarter sections into a corner of a room, the horn's performance will be unaffected.

SB: How did the unusual reflector in the corner horn come about?

VOIGT: The next problem I faced in designing the corner horn was that of obtaining an even distribution around the room. I knew that the low frequencies coming from the horn would diverge while the higher tones would be projected more or less in a beam. The high frequency beam would tend to strike the lower concave section, and the more divergent lower frequencies would be reflected by the larger concave surface. So I aimed at a 30 degree reflection up and down, so as to cover persons either sitting or standing, and of course anywhere in between. (Editorial note: Voigt received British Patent number 404,037 in 1934 for this feature.)

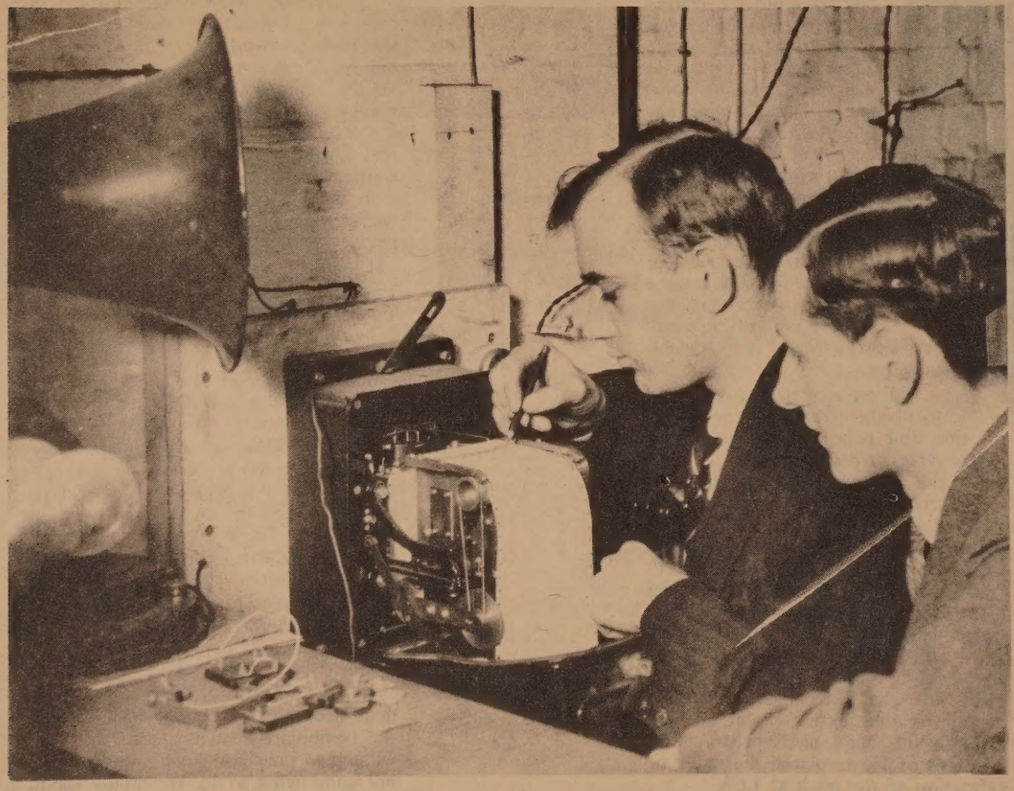


**Figure 5 Voigt (left) is taking a response curve on a recorder at Voigt Patents, Ltd. in the late 1930's. From Wireless World, July 21, 1933; " Mr. P.G.A.H.Voigt, for some time chief research engineer of Edison-Bell, Ltd., has acquired the stocks of Edison-Bell-Voigt moving coil loudspeakers and electrostatic microphones and has formed a company, Voigt Patents, Ltd., to carry on the manufacture of high grade electroacoustic devices."**

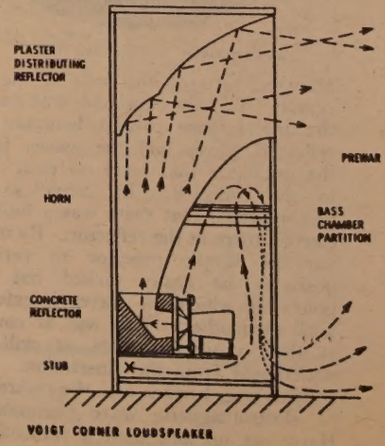



**Figure 6 (a) Cross section of the Voigt Domestic Corner Horn. The horn portion had a response down to 100 Hz, and the bass chamber used a λ/4 tapered pipe resonant at 50 Hz to supply the bass.** [15]

SB: Why did you develope the λ/4 tapered pipe loudspeaker enclosure?

VOIGT: In 1933-34, I was very much concerned with trying to increase the amount of bass you can get with a fairly small cone. That cone was already driving a short horn, but the system was inefficient below the horn cutoff. Several cubic feet of space was available in the cabinet below the horn, and the problem was to find a way to augment the lowest frequencies within the available volume. The method finally adopted used a tapered folded pipe (rather like the neck of a horn) which exhausted near the floor. I named the bass department of the system a bass chamber and would certainly not have done so had I been aware of the impending introduction of what is now called the reflex cabinet. For that has a better right to be called a chamber than my more complex tapered folded pipe system.[4]

In those days any kind of resonance was considered taboo, I refrained from suppying any details. Its main purpose was to provide bass and that covered with the name bass chamber. (Editorial note: It even fooled Percy Wilson, technical editor of Gramophone, who called it a Helmholtz chamber in his review[5] of the Voigt corner horn.)

Actually it behaves like the neck part of a very low frequency horn which stops before the flare is fitted. Technically a quarter wave length resonator will describe it. But since it exhausts at floor level in a corner it is feeding into an eighth sphere and so it is well loaded and therby highly damped. Additionally the floor and sides of the room act as a substitute flare, so the mouth reflection to be expected from a quarter wavelength pipe resonator is very much reduced therby widening the skirts of the response on each side of the peak which itself is so much damped that there is no noticable boominess.

(See figure 7 for an explanation of the λ/4 tapered pipe enclosure.)

(Editorial note: Voigt was granted British Patent number 447,749 for the above idea.)

SB: Did you have any problems with the response of the corner horn?

The corner horn in a living room setting. The base measured 2 x 2 ft. square. Although not excessively large by today's standards, Voigt must have encountered resistance from the distaff side. A 1937 ad, written by Voigt, asks " Imagine how fine it would sound in your own room.....Imagine your wife's remarks! Then write to us for details of how to get even better results as well as the approval of the ladies." A corner horn with a white finish sold for £. 32 in 1937.

VOIGT: I did have trouble with a bump with our domestic corner horns. By themselves they sounded fine, but when compared with the four foot mouth straight horns that bump could be detected easily on the comparison. I tried all kinds of things, thin ply for the back boards, saw slots etc. Every batch of horns for a year or so included some experimental ideas.

In order to help me with putting the problem on a proper footing, I started a year or so before the war on developing a tone burst test of a simple kind. I made the burst last 100 ms and the space 100 ms by switching from a shaft at rps synchronized with the mains by gearing off a Baird scanning disc motor. (Baird was an early English television experimenter.) With this I could show quite clearly a hangover at about 100 Hz. So at least I knew that our corner horns were not aperiodic around the horn limit frequency. By various experiments, I could push the hangover frequency about, but I could not get rid of it at that time. I never completed the total system or solved the problem; it was some probler that we had with Hitler that messed up further progress.

After the war I brought a double beam Cossor oscilloscope and was able to show that at the bump frequency the phase up and down the horn flare was

substantially the same. This is what occurs in a Helmholtz resonator. So my belief that there was some kind of resonance was confirmed again. It could be a cavity resonance. I did start some experiments for absorbing it electrically or mechanically, but I was never able to finish them.

SB: How were your speaker diaphragms made?

VOIGT: What I used for my diaphragms was white paper as used by the draftman on his drawing boards. It was handy and available for the asking. I cut it to shape, bent the cone on the appropriate former and glued the overlap seam with celluloid cement.

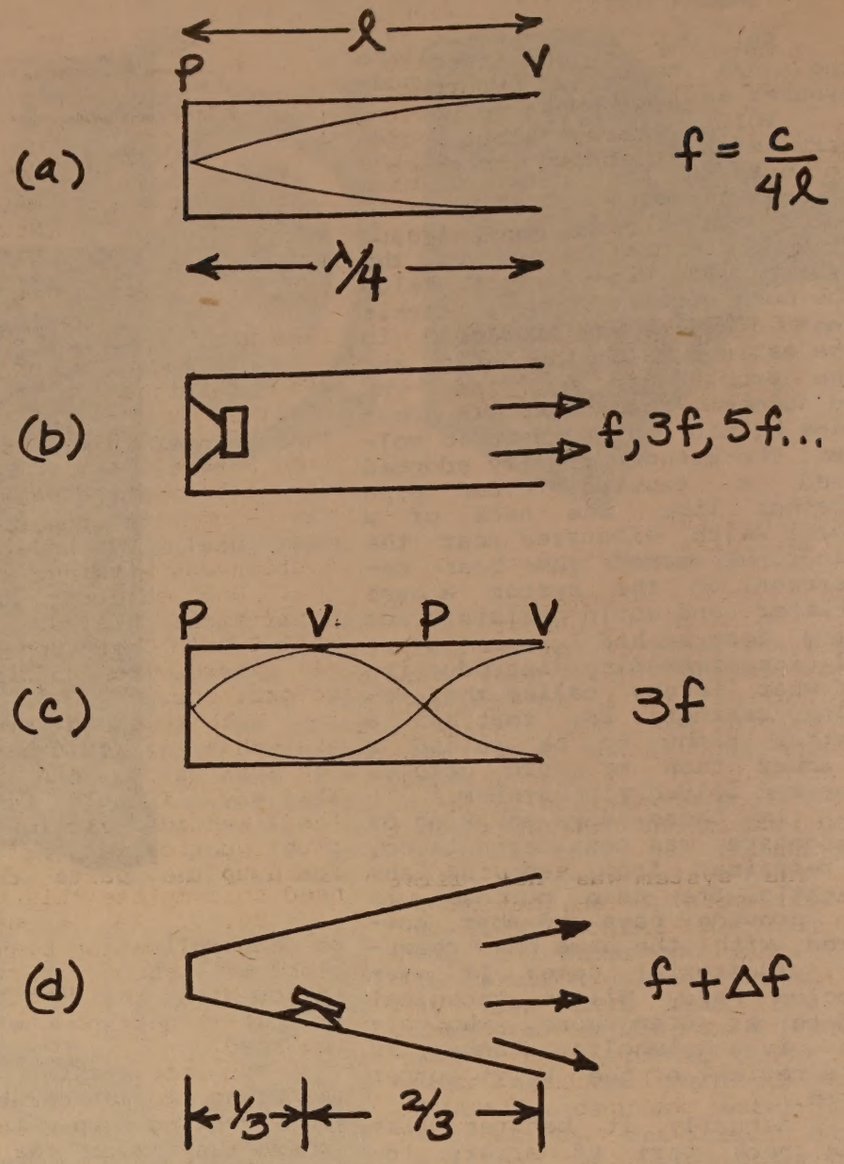
Of the techniques developed as between the paper makers and the mass production speaker makers, I have no knowledge. I imagine that the dies for forming the paper were not cheap.

Later, when diaphragms were being made for straight horn speakers for talkies, the assembled diaphragm was sprayed with mahogany coloured shellac using a hand operated "FLIT" gun sold for spraying anti-fly liquids, (also something readily obtainable.)

To start with, the frame around the diaphragms was made of wood, the outside being rectangular (almost square) while the opening (naturally) was round. In the early days, the flexible surround was of chamois leather which could be stuck on. There were two reasons for changing that. One was that it was not as elastic as I thought desirable. The other reason was that I had news that in some cinemas, the mice found it good to eat.

As things improved, the frames were made of die cast aluminum. and for surround I used a red material which I think was a form of crepe rubber. It came from the Malay States and was sold in England under the name Linatex. An aluminum ring was used to clamp the linatex to the paper diaphragm. The mice showed no interest in that material, but like rubber materials in general there was perishing with time. This was affected by the atmosphere. In most cinemas, a life of 4 or 5 years was quite usual, but in seaside towns might be only half that. In the domestic corner horns of 1934 onwards a longer life was normal. During the later fifties, while living in Toronto, I was introduced to a flexible plas-

Figure 7




The Voigt quarter wavelength bass loading enclosure relies on the fact that a λ/4 closed pipe resonates at the fundamental and odd harmonics. In (a) the fundamental standing wave has a pressure maximum (P) at the closed end and a velocity maximum (V) at the open end. A loudspeaker will be properly loaded if placed at the pressure maximum in (b), but it will radiate at the fundamental and all the odd harmonics. At the third harmonic there are two pressure and velocity maximums as shown in (c). Voigt found that if he placed a driver unit a 1/3 of the length down from the closed end (d), the speaker is near a pressure minimum of the third harmonic, reducing the third harmonic excitation. By also tapering the pipe, he was able to broaden the response about the fundamental to give an octave and a half of bass.

tic material about 0.4 mm (from memory) thick, made by DuPont under the name FAIRPRENE M5550. It was not quite as elastic as the Linatex, but for domestic work that is not as important as in a cinema. When we moved away from Ottawa, about 18 years later, it showed no signs of perishing.

(To be continued.)

3. Voigt, P.G.A.H., Letter to Editor, Radio-Electronics, 30, pp 16, 20, 22, Mar. 1959.

4. _____, All About the Reflex Enclosure, Radio-Electronics, 30, p 38, Feb. 1959.

5. Wilson, P., Cabinets for Speakers - II, Gramophone, 14, p 354, Jan. 1937

14. The Voigt Loudspeaker, Gramophone, 10, p298, Dec. 1933.

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# letters

Editor,
The Horn speaker
Dallas, Texas

Fred Geer's September "Shop Talk" note on the number- letter-number system of tube identification was clear and informative, and I am sure will be helpful to many readers. However he makes one mis--statement of fact that may cause some confusion in dating period tubes and the sets that use them.

The system was not first used on metal tubes, but on the glass types 2A3, 2A5, 5Z3 and 25Z5 that appeared in June 1933. In the following two years it was used on other glass types such as 2A7, 6D6, 6C6, etc., as they were developed. The metal tube with its octal base was not introduced until June 1935 and used the system too, as Fred says.

Frank Kohl
McLean, Virginia

Dear Sir,

I recently picked up a mid thirties H. H. Scott "Philharmonic" (the one with the pointer dial) at alocal flea market.

All that I really got was the complete tuner section, with dial. The power-amplifier section was missing, along with dial and selector knobs with escutchion plates. However, what I did get appears to be all there with no missing tube covers, etc.

With this in mind, I figure that it would be a good idea for me to join your club. This way, I could run an ad in the "wanted" section of your club publication and perhaps round up the parts that I will need to complete this project.

So.... How about sending me an application blankfor your club? I'll shoot it right back to you with the required dues and start getting this show on the road.

You see, this project is important to me because as a kid growing up in Chicago (where they made the Scott radios) in the late thirties and early forties, I remember seeing the Scott ads in the Chicago Tribune. At that time you could buy a good car for what they were asking for the Scott "Philharmonic."

At any rate, as the years went by, I despaired of ever owning the Scott of my dreams -- but I still remember those ads. Now at last I own one. Or, at least a good part of one.

Looking forward to hearing from you in the near future I remain,

Wilbur F. Sanders

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2. **Date of filing: Oct. 1, 1981**
3. **Frequency of issue: Monthly except during July and August.**
4. **Location of known office of publication(street, city, county, state, zip code): 9820 Silver Meadow Dr., Dallas, Texas 75217.**
5. **Location of the headquarters or general business offices of the publishers (Not printers): 9820 Silver Meadow Drive, Dallas, Texas 75217.**
6. **Names and addresses of publishers, editor, and managing editor: Publisher: Jim Cranshaw, 9820 Silver Meadow Drive, Dallas, Texas 75217. Editor: Jim Cranshaw, 9820 Silver Meadow Drive, Dallas, Texas 75217. Managing Editor: Jim Cranshaw, 9820 Silver Meadow Drive, Dallas, Texas 75217.**

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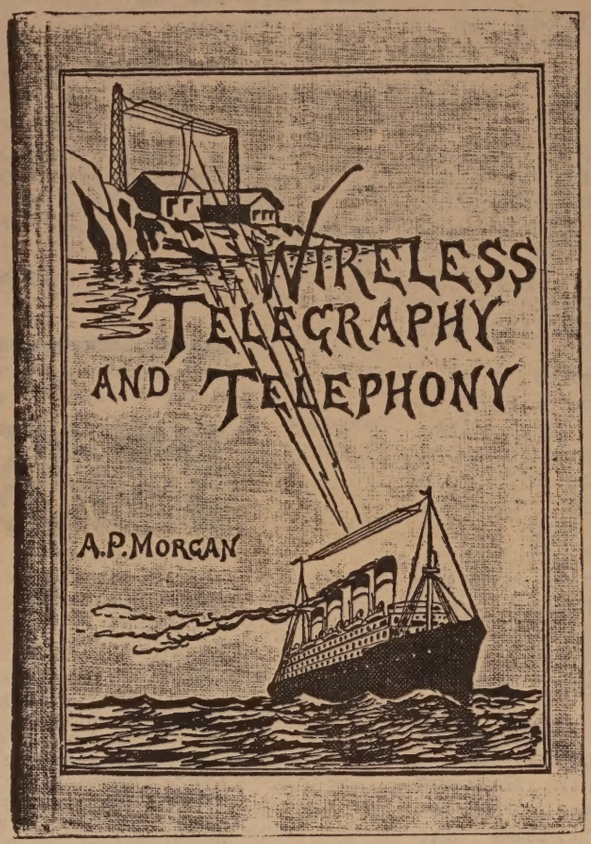


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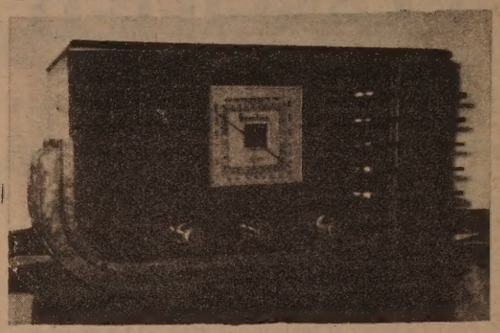

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* OLDE TYME RADIO TUBES tubes from the 20s, 30s, 40s, 50s, and 60s -- used and new -- write for quote.
* EXACT REPLACEMENT RADIOLA II OR VIII LEATHER HANDLES ONLY .. $4.25 each.
* SCHEMATIC FOR SETS MANUFACTURED FROM 1920 THRU 1940 .. $1.50 each.
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* RESISTOR LINE CORD REPLACEMENT KITS: 4-tube .. $3.50 -- 5-tube .. $4.50.
* IF YOU DON'T SEE IT, ASK
* OLDE TYME BATTERY CABLE - all cloth AK style -- 5-conductor .. .75/ft. -- 6-conductor .. 1.00/ft. -- brown silk type power cord .. .30/ft. -- single conductor hookup wire (cloth) .. .12/ft.
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* 10- 10 uf/450 V caps -- $1.00 each or 12 for $1.00
* TUBES SPECIAL -- 6F8, 38, 6C4 - all new in original boxes .. 50 cents each or 3 for $1.00
* OUR SHIPPING POLICY -- Please send sufficient funds to cover shipping costs. Overages if under $1.00 will be credited to future orders - or refunded if requested. Overage over $1.00 will be returned with your order when it is shipped.

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(301) 585-8776

chive. Early carbon, dynamic, condenser or ribbon types. Purchase or trade. James Steele, National Association of Broadcasters, 477 Madison Avenue, New York, NY 10022.

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WANTED: SCOTT PHILHARMONIC - SPECIAL COMMUNICATIONS RECEIVER - PHANTOM DELUXE. Also early All- Wave series in original cabinets. Zenith Stratosphere also wanted Highest cash price paid for any of these sets. Also have rare Federal 161 for trade. Dave Pierson, 635 E. Buchtel, Akron, OH 44304. (216) 762-5978.

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WANTED: SMALL SIZE COMMUNICATION TYPE SETS. (no junk). Please write and tell me what you have and the price. William Hemrick, Route 1, Terra Alta, WV 26764.

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HI-FI, TAPE, AUDIO, and retail magazines --- and --- brochures: 1945-55 only; Precedent FM tuner; early 1950's transistor sets. H. Layer, AV-SFSU, 1600 Holloway, San Francisco, CA 94132.

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## ANTIQUE RADIO TOPICS & THE CLASSIC RADIO NEWSLETTER

LIST N/19

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ALL TUBES ARE GUARANTEED - SEE TERMS OF GUARANTEE STATED IN OUR CATALOG.

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| 0A4 | $3 | 1H6 | $6 | 2A6 | $7 | 6A7 | $9 | 6B8 | $7 | 0R6 | $5 | 6ST7 | $5 | 7B7 | $7 | 12AT7 | $4 | 12SR7 | $5 |
| 0B3 | $4 | 1J5 | $6 | 2A7 | $6 | 6A8 | $7 | 6BA6 | $3 | 6K7 | $6 | 6SU7 | $5 | 7B8 | $6 | 12AU6 | $3 | 12SW7 | $5 |
| 0C3 | $4 | 1J6 | $6 | 2B7 | $8 | 6AB4 | $4 | 6BE6 | $4 | 0K8 | $6 | 6SV7 | $5 | 7C5 | $5 | 12AU7 | $3 | 12V6 | $4 |
| 0D3 | $4 | 1L4 | $6 | 2E5 | $10 | 6AB5 | $12 | 6BJ6 | $4 | 6L5 | $6 | 6SZ7 | $5 | 7C6 | $8 | 12AV6 | $4 | 12Z3 | $4 |
| 0V4 | $4 | 1L6 | $12 | 2W3 | $4 | 6AB7 | $6 | 6C4 | $4 | 6L6 | $5 | 6T7 | $6 | 7C7 | $6 | 12AX7 | $4 | 14A4 | $6 |
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| 1A4 | $6 | 1LB4 | $7 | 3A5 | $5 | 6AD5 | $7 | 6C7 | $7 | 6N6 | $6 | 6U6 | $4 | 7F7 | $12 | 12B8 | $6 | 14AF7 | $6 |
| 1A5 | $5 | 1LC5 | $6 | 3A8 | $6 | 6AD6 | $9 | 6C8 | $6 | 6N7 | $6 | 6U7 | $7 | 7F8 | $9 | 12BA6 | $4 | 14B5 | $6 |
| 1A6 | $5 | 1LC6 | $6 | 3B5 | $5 | 6AH7 | $6 | 6CB6 | $3 | 6P5 | $5 | 6V6 | $3 | 7G7 | $7 | 12BE6 | $4 | 14B6 | $6 |
| 1A7 | $4 | 1LD5 | $6 | 3B7 | $5 | 6AE5 | $5 | 6D4 | $5 | 6P7 | $8 | 6V7 | $5 | 7H7 | $6 | 12C5 | $5 | 14B8 | $6 |
| 1B4 | $6 | 1LE3 | $6 | 3C6 | $6 | 6AE6 | $6 | 6D6 | $7 | 6Q7 | $6 | 6W6 | $4 | 7J7 | $7 | 12C8 | $6 | 14C5 | $5 |
| 1B5 | $6 | 1LF3 | $6 | 3LF4 | $6 | 6AE7 | $6 | 6D7 | $7 | 6R7 | $6 | 6X4 | $4 | 7K7 | $8 | 12F5 | $5 | 14C7 | $6 |
| 1B7 | $6 | 1LD5 | $6 | 3Q4 | $5 | 6AF3 | $6 | 6D8 | $7 | 6S4 | $5 | 6X5 | $4 | 7L7 | $7 | 12H6 | $4 | 14E6 | $6 |
| 1C5 | $4 | 1LH4 | $6 | 3Q5 | $5 | 6AF6 | $4 | 6E5 | $12 | 6S7 | $6 | 6Y6 | $5 | 7N7 | $10 | 12J5 | $6 | 14E7 | $6 |
| 1C6 | $5 | 1LN5 | $6 | 3S4 | $4 | 6AG5 | $4 | 6E8 | $5 | 6S8 | $7 | 6Z4 | $6 | 7Q7 | $6 | 12J7 | $5 | 14F7 | $7 |
| 1C7 | $6 | 1N5 | $6 | 3V4 | $5 | 6AG7 | $5 | 6E7 | $7 | 6SA7 | $5 | 6Z5 | $6 | 7S7 | $7 | 12K5 | $7 | 14F8 | $8 |
| 1D5 | $6 | 1N6 | $6 | 5AZ4 | $8 | 6AH5 | $5 | 6E8 | $6 | 6SB7 | $6 | 6Z7 | $6 | 7S7 | $7 | 12K8 | $6 | 14H7 | $6 |
| 1D7 | $6 | 1P5 | $5 | 5R4 | $5 | 6AH7 | $5 | 6F5 | $6 | 6SC7 | $6 | 6ZY5 | $6 | 7V7 | $6 | 12L6 | $4 | 14J7 | $7 |
| 1D8 | $6 | 1Q5 | $5 | 5T4 | $5 | 6AK5 | $3 | 6F8 | $6 | 6SD7 | $5 | 7A4 | $6 | 7W7 | $6 | 12Q7 | $6 | 14N7 | $6 |
| 1E4 | $5 | 1R4 | $6 | 5U4 | $4 | 6AL5 | $4 | 6F7 | $7 | 6SE7 | $5 | 7A5 | $5 | 7X6 | $7 | 12SA7 | $5 | 14Q7 | $6 |
| 1E5 | $6 | 1R5 | $3 | 5V4 | $5 | 6AL7 | $9 | 6F8 | $5 | 6SF5 | $5 | 7A6 | $6 | 7X7 | $7 | 12SB7 | $6 | 14R7 | $6 |
| 1E7 | $6 | 1S4 | $4 | 5W4 | $5 | 6AQ5 | $4 | 6G5 | $12 | 6SF7 | $5 | 7A7 | $6 | 7Y4 | $6 | 12SC7 | $6 | 14W7 | $6 |
| 1F4 | $6 | 1S5 | $4 | 5X4 | $5 | 6AQ7 | $5 | 6G6 | $5 | 6SG7 | $6 | 7A8 | $6 | 7Z4 | $6 | 12SF5 | $5 | 14X7 | $7 |
| 1F5 | $6 | 1T4 | $5 | 5Y3 | $5 | 6AT6 | $4 | 6H4 | $5 | 6SH7 | $6 | 7AD7 | $6 | 10 | $9 | 12SF7 | $5 | 15 | $9 |
| 1F6 | $6 | 1T5 | $5 | 5Y4 | $5 | 6AT8 | $5 | 6H6 | $3 | 6SJ7 | $5 | 7AE7 | $6 | 12 | $8 | 12SG7 | $6 | 19 | $7 |
| 1F7 | $6 | 1U4 | $5 | 5Z3 | $5 | 6AU6 | $3 | 6J4 | $5 | 6SK7 | $5 | 7AF7 | $8 | 12A5 | $8 | 12SH7 | $5 | 19T8 | $8 |
| 1G4 | $6 | 1U5 | $5 | 5Z4 | $5 | 6AV6 | $4 | 6J5 | $6 | 6SL7 | $6 | 7AG7 | $6 | 12A6 | $6 | 12SJ7 | $5 | 20 | $6 |
| 1G5 | $6 | 1V | $6 | 6A5 | $6 | 6B4 | $6 | 6J6 | $3 | 6SN7 | $3 | 7AH7 | $6 | 12A7 | $7 | 12SK7 | $5 | 22 | $8 |
| 1G6 | $6 | 2A3 | $10 | 6A4 | $7 | 6B5 | $7 | 6J7 | $6 | 6SQ7 | $5 | 7B4 | $6 | 12A8 | $6 | 12SL7 | $5 | 24A | $7 |
| | | | | | | | | | | | | | | | | | | | |
| 25A6 | $6 | 56 | $6 | 59 | $9 | 1201 | $6 | | | | | | | | | | | | |
| 25A7 | $6 | 57 | $6 | 70A7 | $7 | 1203 | $6 | | | | | | | | | | | | |
| 25AC5 | $6 | 58 | $6 | 70L7 | $8 | 1231 | $6 | | | | | | | | | | | | |
| 25B6 | $6 | 59 | $6 | 71A | $9 | 1232 | $7 | | | | | | | | | | | | |
| 25C6 | $6 | 80 | $9 | 75 | $8 | 1273 | $6 | | | | | | | | | | | | |
| 25L6 | $6 | 4025 | $5 | 76 | $5 | 1274 | $8 | | | | | | | | | | | | |
| 25Z6 | $6 | 41 | $6 | 77 | $7 | 1282 | $6 | | | | | | | | | | | | |
| 2525 | $6 | 42 | $6 | 78 | $8 | 1291 | $6 | | | | | | | | | | | | |
| 2526 | $6 | 43 | $7 | 79 | $6 | 1294 | $6 | | | | | | | | | | | | |
| 26A7 | $6 | 80 | $5 | 1629 | $9 | | | | | | | | | | | | | | |
| 26Y6 | $6 | 45 | $10 | 81 | $9 | 1852 | $6 | | | | | | | | | | | | |
| 27 | $7 | 4523 | $3 | 82 | $7 | 1853 | $6 | | | | | | | | | | | | |
| 28D7 | $4 | 4525 | $4 | 83 | $7 | 5881 | $7 | | | | | | | | | | | | |
| 30 | $7 | 46 | $6 | 83V | $7 | 6146 | $7 | | | | | | | | | | | | |
| 31 | $7 | 47 | $9 | 84 | $6 | 9001 | $5 | | | | | | | | | | | | |
| 32 | $6 | 48 | $5 | 85 | $6 | 9002 | $5 | | | | | | | | | | | | |
| 32 | $6 | 49 | $8 | 89 | $6 | 9003 | $5 | | | | | | | | | | | | |
| 32L6 | $4 | 50 | $9 | 117L7 | $9 | 9006 | $6 | | | | | | | | | | | | |
| 33 | $6 | 50A5 | $6 | 117M7 | $9 | VR75 | $4 | | | | | | | | | | | | |
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| 34 | $7 | 50C5 | $3 | 117P7 | $8 | VR105 | $4 | | | | | | | | | | | | |
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| 3525 | $5 | 57 | $7 | 955 | $7 | | | | | | | | | | | | | | |
| 3526 | $6 | 58 | $8 | 958 | $7 | | | | | | | | | | | | | | |

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1981

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